

Modeling of local edge plasma perturbations induced by a biased probe

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In the “death-ray” regime often seen in tokamak edge plasma experiments, the downstream electron pressure, as measured by Langmuir probes at the divertor plate, exceeds the upstream values by nearly a factor of 2 over a narrow radial region at the strike point [1,2]. However, recent studies on Alcator C-Mod indicate that the death-ray over-pressure may be a result of local plasma perturbation by the negative probe bias [3]. We investigate the effects of probe perturbation of the plasma using the tokamak edge fluid code UEDGE. The code models a 2D slab-like configuration roughly matching the basic dimensions and characteristics of edge plasma in Alcator C-Mod near detachment, where the death-ray is often observed. In the code setup, a small axisymmetric segment of target plate is biased, which mimics a plate-mounted Langmuir probe. It is observed in the numerical solutions that at sufficiently negative bias voltage, the probe substantially modifies the local plasma characteristics. Detailed mechanisms of this perturbation are investigated, and the implications are discussed. Work performed for U.S. DoE by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

[1] B. LaBombard et al., Journal of Nuclear Materials, 241-243, p. 149-166 (1997)

[2] A. Loarte et al., Nuclear Fusion 38 (1998) 331.

[3] D. Brunner et al., APS DPP 2010, poster TP9.00069